Mathematics for the Technologies 4

Course Description

The Probability and Statistics Course Standards from the South Carolina Mathematics Curriculum Standards are shown in green and in bold print at the places in the course outline where they should be addressed. In many cases, a standard will be found in more than one place in the outline.

Mathematics for the Technologies 4 focuses on the development of the student's understanding of and ability to apply mathematics to solve real-world problems dealing with probability, statistics, and data analysis. Students should have mastered Algebra 1 (Mathematics for the Technologies 1 and 2) standards prior to enrolling in this course. Students are expected to utilize scientific calculators, graphing calculators, and/or computer software throughout the course. It is recommended that class size be no larger than twenty-two students due to the hands-on, laboratory-based nature of this course.

Classroom teachers will determine, based upon the needs of students, the emphasis given to the various topics and the extent of calculator or computer use. Classroom teachers are encouraged to work with occupational instructors and local businesses to incorporate career and technology applications of mathematics in the workplace.

Students will

- work with a set of data to perform statistical analyses and summarize the results;
- examine ways to organize and display data to draw conclusions about relationships that may exist in the data set;
- describe and summarize data numerically using central tendency, variation, and position statistics;
- describe and summarize data numerically using distributions;
- utilize statistical applications to solve problems from a workplace or manufacturing environment;
- use counting methods and probability formulas to evaluate the likelihood of events occurring; and
- apply probability as a decision-making tool to workplace applications.

Recommended Prerequisites

Students entering this course should have successfully completed Mathematics for the Technologies 1 and Mathematics for the Technologies 2 or Algebra 1, having mastered all state-mandated standards through Algebra 1. (Successful completion of Mathematics for the Technologies 3 is also recommended prior to this course.)

Course Outline

I. Foundations of data analysis.
   A. Differentiate between descriptive and inferential statistics. **Probability and Statistics: I.A.2.**
   B. Identify and classify variables.
      1. Discrete or continuous. **Probability and Statistics: I.B.1.**
      2. Categorical or quantitative. **Probability and Statistics: I.B.1.**
   C. Identify and classify methods of data collection.
      1. Identify basic sampling techniques. **Probability and Statistics: I.A.2.,3. III.A.1.,2.**
         a. Random.
         b. Systematic.
         c. Stratified.
         d. Cluster.
      2. Discuss the advantages and disadvantages of various sampling techniques.
      3. Distinguish among surveys, observational studies, and controlled experiments. **Probability and Statistics: I.A.1.,4.,5.,6.**
      4. Recognize the method of data collection used to gather data from a given statistical study. **Probability and Statistics: I.A.2.**
      5. Identify and discuss bias factors (e.g., voluntary response, convenience). **Probability and Statistics: I.B.2.**

D. Distinguish between statistic and parameter. **Probability and Statistics: I.D.1.**

II. Univariate data displays.

A. Determine an appropriate data display, and construct the display. **Probability and Statistics: I.C.1.,2.**

1. Pictograph. **Probability and Statistics: II.A.1.**
2. Dot plot. **Probability and Statistics: II.A.1.,2.**
3. Bar graph. **Probability and Statistics: I.C.1., II.B.4.**
4. Pie chart. **Probability and Statistics: I.C.1.**
5. Frequency distributions.
   a. Categorical frequency distribution (Pareto chart). **Probability and Statistics: I.C.1., II.B.4.**
   b. Histogram. **Probability and Statistics: I.C.2.**
   c. Frequency polygon.
   d. Cumulative frequency distribution (ogive).
6. Time series plot.
7. Stem plot (stem-and-leaf). **Probability and Statistics: I.C.1,2.**
   a. Standard.
   b. Back-to-back (to compare two data sets with common stems).
   c. Expanded (stem expansion based on the number of data values within the stem; i.e., group by five or two as needed).
   d. Truncated (data is rounded before use)—optional.
8. Box plot (box-and-whisker)—teach in conjunction with measures of position. **Probability and Statistics: I.C.1.,2.**
   a. Single.
   b. Parallel (horizontal or vertical arrangement with a common scale for comparing data sets).

B. Interpret the graphical display.

1. Center. **Probability and Statistics: I.D.2., II.C.1.**
   a. Mean.
   b. Median.
   c. Mode.
2. Spread **Probability and Statistics: I.D.2., II.C.1.**
   a. Range.
   b. Variance.
   c. Standard deviation.
   d. Mean deviation (optional).
   e. Interquartile range (IQR).
3. Position. **Probability and Statistics: I.D.3.**
   a. Median.
   b. Quartiles.
   c. Deciles.
   d. Percentiles.
   e. Standard scores (z-scores).
4. Shape. **Probability and Statistics: II.A.1., C.2.**
   a. Symmetric.
   b. Skewed.
5. Outliers. **Probability and Statistics: I.C.1.,2.**

III. Applications of measures of central tendency and variation.

A. Solve problems in manufacturing and/or business environments. **Probability and Statistics: III.D.1.**

1. Control charts.
2. Process and quality control.
3. Calculation of capability indexes.
4. Computer graphing utilities.

B. Analyze precision, accuracy, and approximate error in measurement situations. **Probability and Statistics: I.A.3..**

C. Solve problems using the normal curve. **Probability and Statistics: II.A.3.**

IV. Basic probability concepts and applications .

A. Apply counting techniques to determine the number of outcomes. **Probability and Statistics: IV.A.1.**

1. Tree diagram. **Probability and Statistics: IV.A.2.**

2. Counting principle. **Probability and Statistics: IV.D.3.**
3. Permutations (with and without repetition). **Probability and Statistics: IV.A.1.**
4. Combinations.
    a. Pascal's triangle and binomial coefficients (optional). **Probability and Statistics: IV.A.3.**
    b. Committees as subgroups of larger group . **Probability and Statistics: IV.A.1.,2.**

B. Determine and display a sample space. **Probability and Statistics: IV.A.2.**
1. List.
2. Chart.
3. Picture.
4. Tree diagram.

C. Compute and display classical (theoretical) and empirical (experimental) probability. **Probability and Statistics: IV.E.1.**
1. Simple.
2. Complementary.
3. Compound. **Probability and Statistics: IV.E.1.**
    a. Mutually exclusive (disjoint) events. **Probability and Statistics: IV.D.1.**
    b. Inclusive (joint) events.
    c. Independent events.
    d. Dependent events.
4. Conditional probability. **Probability and Statistics: IV.D.2.**
5. Use Venn diagrams or two-way tables to illustrate simple, complementary, compound, and conditional probability. **Probability and Statistics: IV.A.2.**

D. Conduct and interpret simple probability experiments. **Probability and Statistics: IV.B.1.,2.**
1. Manipulatives (e.g., spinners, dice, cards, and coins).
2. Simulations (using random number tables, graphing calculators, or computer software).

V. Probability distributions.

A. Construct a classical (theoretical) probability distribution using a sample space. **Probability and Statistics: IV.A.1.**

B. Construct an empirical (experimental) probability distribution using simulation. **Probability and Statistics: IV.B.1.**

C. Compare classical (theoretical) probabilities from the sample space to the empirical (experimental) probabilities from a simulation. **Probability and Statistics: IV.B.1.**

D. Calculate the mean of a probability distribution, and apply it to expected value problems. **Probability and Statistics: IV.C.2.**

E. Solve problems using the binomial probability distribution table. **Probability and Statistics: IV.A.3.**

VI. Bivariate data and scatter plots.

A. Construct a scatter plot from given data. **Probability and Statistics: II.B.3.**

B. Describe the shape of a scatter plot as linear, quadratic, or exponential. **Probability and Statistics: II.B.3.**

C. Examine scatter plots to determine positive, negative, or no correlation. **Probability and Statistics: I.D.5.**

D. Write a linear equation that represents the relationship between the variables. **Probability and Statistics: II.B.2.,3.**
1. Intuitive methods (estimate using linguini or clear ruler). **Probability and Statistics: II.D.1.**
2. Median-median line (optional).
3. Linear regression using a graphing calculator or computer software (and interpret the meaning of the correlation coefficient, r). **Probability and Statistics: II.B.1.,3., D.2.**

E. Make predictions (interpolate or extrapolate). **Probability and Statistics: II.B.2.**

F. Explain limitations of the linear model. **Probability and Statistics: II.B.2.,3.**

VII. Project design.

A. Use any of the statistical and probability knowledge to design a culminating project.
1. Experiments. **Probability and Statistics: I.A.1-7., B.2.**
2. Observational studies. **Probability and Statistics: I.A.1.**
3. Surveys.

B. Collect, analyze, and display the data. **Probability and Statistics: I.A.2.,3., C.2., III.A.1.,2.**

C. Produce a report.

VIII. Optional topics.

A. Hypothesis Testing. **Probability and Statistics: III.D.2**

1. Write null and alternate hypotheses.
2. Test hypotheses. .
    a. Difference between two means.
    b. Difference between two proportions.
    c. Chi-square procedures. **Probability and Statistics: IV.C.1.,2.**
    d. Non-normal distributions.
    e. T distributions.

B. Confidence intervals. **Probability and Statistics: III.D.1.**

C. Curves of best fit. **Probability and Statistics: III.D.2.**